



THE MEMBERS MAGAZINE OF THE NATURAL
HISTORY MUSEUM OF LOS ANGELES COUNTY

Terra

Vol. 18/No. 2

CURATORS AND COLLECTIONS

KATHARINE BIXBY HOTCHKIS,
1899-1979

Katharine Bixby Hotchkis, a member of TERRA's editorial board since 1964, died on October 10th after a long illness. She loved truth, causes worth fighting for, and people. She hated sham, banality, and shoddiness. She was reverent toward nature and irreverent about herself. When she became too ill to attend TERRA's meetings she was embarrassed that her name still appeared on the masthead—and asked that it be removed. This editor wrote back to say that the name would remain, serving as a reminder to us of the importance of continuing to strive for excellence in the face of some tough opposition. She was valiant. We shall try to live up to her.

FATHER OF THE BOTANY COLLECTION

In this issue of TERRA with its strong emphasis on botany, it is interesting to turn to the source of the Museum's first botanical collection. According to Museum historian Gretchen Sibley, the file from the records reads:

A114, Gift of Davidson, Anstruther: Botanical specimens, bulletins, books, lantern slides, nests and eggs. April 12, 1909.

That date was seven months before the official opening of the Museum. And the botanical specimens were the first of more than 8000 provided by Dr. Anstruther Davidson over the next years.

Anstruther Davidson was a Scottish doctor who came to Los Angeles in 1887. He



Three Scotsmen, taken in 1910. On the left, Dr. Anstruther Davidson, with his friends, John Muir, and Andrew Carnegie.

practiced dermatology, but many fields of science were of interest to him. In 1891 Davidson joined a number of scientists to form the Southern California Science Association, which later became the Southern California Academy of Sciences. He married a young botany teacher, Alice Merritt, and became, with her, an ardent botanist.

On weekends the Davidsons would take their two boys on camping and specimen-gathering trips into the Mojave Desert. Back home Dr. Davidson spent long hours in his study working on his collections, and writing articles for the "Bulletin of Southern California Academy of Sciences," and in 1923 completing a book, *Flora of California*. In 1892, before he was married, he'd written *Plants of Los Angeles County*.

Dr. Davidson was appointed as one of the fifteen original members of the Board of Governors of the Los Angeles County Museum of History, Science and Art in 1909 (now the Natural History Museum). He remained in that position for twenty-two years, until his death in 1932. During all that time he enriched the collections of the Museum with a wide variety of specimens.

EARTHWATCH EXPEDITION TO COSTA RICA

In August three Museum staff members conducted a highly successful expedition to the rainforest of northeastern Costa Rica, in cooperation with Earthwatch, a non-profit organization which serves as a clearing-house for volunteers who are eager not only to participate in the field work but to help subsidize its costs.

Team Leader Julian P. Donahue (Assistant Curator of Entomology), Dr. Christopher Davidson (Curator of Botany), and Dr. Robert L. Bezy (Associate Curator of Herpetology) were joined in the field by eleven paying participants—nine through Earthwatch and two through the Museum Foundation. For three weeks the curators and their assistants scoured the jungle, in an area where the virgin forest is being rapidly cleared for agricultural purposes. Each curator had his own separate research goals.

Donahue and Davidson were most interested in salvaging as many of the native insects and plants as they could, before they became rare or extinct due to habitat destruction. Donahue's team collected over 50,000 insects, many of which will undoubtedly prove to be new to science, or new distribution records. Particular emphasis was placed on butterflies and moths, Donahue's research specialty, and many field observations were made on species which visited flowers and dried foliage. Davidson's crew collected, pressed, dried, and photographed more than 700 species of plants, represented by 1,802

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COVER

Kokia Cookei, the last plant of its kind, flowered in June of 1979 at the Waimea Arboretum on Oahu after a long struggle to keep it alive. It is one of many plants featured in the "Hawaii's Unique and Vanishing Flora" exhibit currently on display on the second floor of the Museum. Photo by R. Gustafson

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HAWAII'S UNIQUE AND VANISHING FLORA THE GENESIS OF AN EXHIBIT

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by Robert J. Gustafson

Photographs by David Minor

Hawaii—Land of Flowers. Exotic gingers, spicy plumerias, waxy anthuriums and, of course, the proverbial orchids. Every postcard, guide book, aloha shirt, hotel lobby, ad infinitum, depicts these plants in one way or another, but none of them is native to the Islands. (There are four native orchids, but they are hardly what one would call spectacular.) The only flower that rightfully deserves its popularity is the hibiscus—at least Hawaii's endemic species rival their hybrid cousins in color, but unfortunately most are extremely rare and seldom seen. Hawaii is a land of flowers with a unique and fascinating flora that is rapidly disappearing. Close to fifty percent of the native plants are now considered rare and endangered or already extinct. These are the flowers that most people never see. Pursuing these rarities in the wild is a difficult and sometimes almost impossible task.

My interest in the Hawaiian flora developed many years ago with the idea of doing an exhibit on one of this country's greatest and most interesting botanical resources. There are some 1,380 native species of plants known from the Islands

with more than 96.6% endemic (that is, not found outside of Hawaii) and 3.4% indigenous (with a greater geographical distribution than Hawaii). If one counts up all the subspecies, varieties and forms of the known plants, there are some 2,650 distinct botanical entities present in the chain, which extends from the big island of Hawaii to Kure and Midway Islands some 1,600 miles to the west.

Because the islands are geographically isolated in the mid-Pacific and also remote from one another, many unusual plants have evolved over the millennia. Isolated pockets of vegetation (or *kipukas*) which occur on the recent islands by way of lava flows, together with the formation of deep valleys due to erosion of the various volcanic cones, have created an "island-within-an-island" effect. These isolation factors have contributed to the many species one finds in some of the Hawaiian genera.

Searching for some of the islands' rarer plants has led to unexpected problems. In many instances access to trails is difficult and restrictions are common. One does not hike on Hawaiian watershed, for example, without first submitting to a stool test for intestinal parasites. A stiff fine may be levied to those who do not comply. Many trails cross private prop-

erty, and permission must be secured ahead of time. Quite often finding where a trail begins can become a "needle-in-a-haystack" affair unless one has a guide who knows precisely what turn in the road he should take. The trails are often precipitous, muddy, narrow, overgrown with vegetation or combinations of all the above. Perhaps I could say the more elusive the plant, the harder the hike. And yet finding a "treasure" at the end of a long run when hamstrings are aching and the throat is parched for a cold beer and the sweat is pouring out in streams is a kind of mental exhilaration that is difficult to describe. The camera dutifully records the moment, but viewing a slide or looking at a photograph later on never quite brings back that initial excitement.

Over the past few years I have been fortunate to have had museum docents, research associates and other botanists accompany me on an annual trip to Hawaii. The group gets put through their paces, because time is short and usually many objectives must be accomplished. Apart from swollen feet or a twisted ankle, most have made it through relatively intact. No one has ever fallen off a cliff (although I must confess to having made a few miscalculations in my time that could have had disastrous results).

The black and white photos for this article are done by David Minor. The color plant photos are by Robert Gustafson.

Hibiscus kokio v. pukoonis—a rare *Hibiscus* native to the island of Molokai.



Hibiscadelphus distans—a very rare member of the mallow family discovered in Waimea Canyon, Kauai, within the last decade.





Carrying a camera bag and assorted paraphernalia plus a collecting bag for plant material can become somewhat of a liability on a knife-edge trail where balance is important. Misjudging a hog wallow can also be mildly disconcerting, as one staff member who shall remain nameless found out last summer while hiking up to Molokai's Pepeopae Bog. But muddy clothes do dry out—eventually.

Not all of Hawaii's rare plants are in inaccessible areas. While searching for a very rare coastal plant known to grow on a consolidated sand dune in the middle of a golf course, we encountered an unexpected problem. The plant in question was known to occur about 150 feet above the first golf tee (the data was taken from a herbarium label on a collection made many years ago). We found the first golf tee, and four of us proceeded to climb up a sandy embankment intently looking for our quarry, totally unaware of a loud-speaker ordering us out of the area. It took a while for it to sink in that we were the party in question. A group of golfers was waiting to tee off, but since we were pos-

sible targets for an out-of-bounds ball, they could not proceed with their game. It was decided at that time to let the clubhouse know of our activities. We found out that the golf course had considerably expanded since the collection of the plant ten years previously, and what was once the first was now the fifth tee. To make a long story short, we found the fifth tee and located the plant shortly thereafter.

The display currently on view in the botany hall of the museum features many of the island's rare and unusual plants in a retrospective of over five years of photography. Each trip has yielded many new discoveries, and one hopes successive trips over the next few years will be equally rewarding. I believe that this is the first major exhibit on the Hawaiian flora to appear in this country. Included are some of the Islands' more common species, and many of those that were utilized by the Hawaiians since their colonization many centuries ago.

Some of the rarest plants in the world

Botanist William Martin surveys a tree fern forest on the Waikamoi Flume, Maui.

are also featured, including the plant I chose to regard as the theme of the exhibit, *Kokia cookei*. This striking member of the mallow family, the last plant of its kind, flowered during the early summer of 1979 in the Waimea Arboretum after a long and arduous attempt to keep it going. We hope it will produce viable seed, much needed to ensure its future in the years to come.

Since many of Hawaii's plants are on the borderline of extinction, individuals with great foresight saw fit to propagate many of these rarities before they were totally obliterated in the wild. To anyone interested in viewing some of these plants firsthand, there are some very fine arboreta in the Islands that are specializing in the native flora—the Waimea Arboretum on Oahu, Pacific Tropical Botanical Garden on Kauai, Manuka Wayside Park on Hawaii, and the Maui Zoological and Botanical Gardens on Maui, to mention a few.



Docent Lynn Levin, biologist Laurel Woodley and the author surveying a population of Ses-

bania tomentosa on Moomomi Beach, Molokai.



Docent Betty Birdsall aids the author in pressing plants on Kauai.

How well does the future bode for plant and animal life on the Islands? I wish I could express more optimism, but for many of these biological entities it is already too late. More plants and birds have become extinct over the last one hundred years in the Hawaiian Islands than on the entire continent of North America. The Islands' delicate ecological balance was drastically overthrown shortly after Captain Cook discovered them near the end of the eighteenth century. The introduction of grazing animals was unleashed on a flora that evolved without the presence of herbivores. How many plants disappeared before Hillebrand published his flora of Hawaii in 1888 no one will ever know. The Polynesians who first colonized the islands undoubtedly messed up this pristine paradise by introducing pigs and plants like the coconut, ti, and taro, among others, but with the advent of the white man in the nineteenth century, the process accelerated. Since that time, other plant introductions such as lantana, "hale koa" (*Leucaena leucocephala*) and blackberries (*Rubus* sp.) have competed with, and in many cases outdistanced, the native flora. Introduced animals, like the mongoose, preyed on native birds, reducing avian fauna that was never common to begin with. The advent of exotic birds brought in avian malaria for which the native species had no defenses.

Hawaii is a paradise in peril. Unless the appetite for more condominiums, hotels, ranch and farm lands is somehow curbed, very little will be left for future generations to enjoy.

Robert Gustafson continues to hunt for rare and endangered Hawaiian plants. He hopes to raise the public's awareness of disappearing floras before many botanical entities pass into extinction.

Scaevola kilaueae—a rare plant known only from the lava flows southeast of Kilauea, Hawaii.



Gossypium sandwicense—the native Hawaiian cotton is becoming rare in its coastal habitat.



Narcissus. This fragrance intoxicated The Furies.

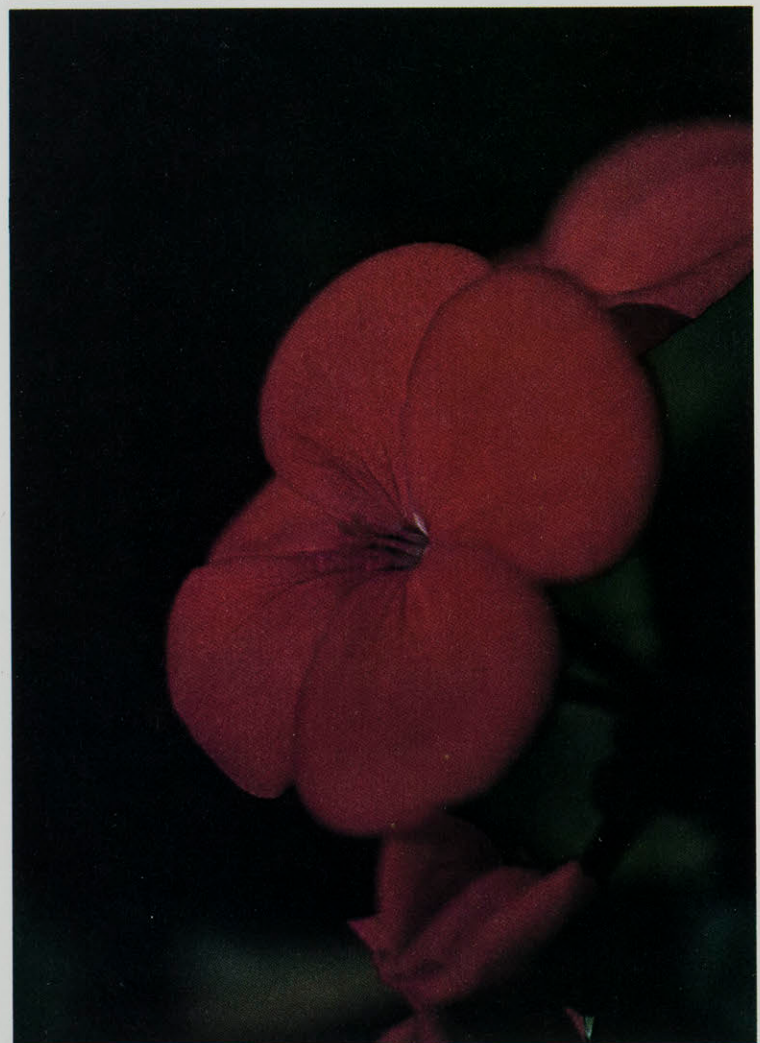
BELOW

Geranium leaves provide a host of fragrances.

OPPOSITE PAGE

Egyptian woman wearing a resin cone on her head.

Courtesy Metropolitan Museum of Art.



ORIGINS AND USES OF SCENTS



Few civilized nations still allow the natural odors of fatty acids and other exudates of the human body as acted upon by bacteria to determine the scent an individual bears. Instead, in increasing numbers, both men and women scent themselves with exotic oils and distillates. The prehormones of swine and other beasts that rely upon scent to elicit courtship behavior have been analyzed, and it is often simply a matter of spraying a scent to elicit lust. Humans may have the same biological basis for romantic behavior, witness the unprintable petitions from Napoleon I to Josephine in which he implored her to retain for him those odors peculiar to her body. However, she was given to violets, hyacinths and lily of the valley to scent her body, and it is doubtful if the Emperor ever knew the natural odors of his consort.

Why have men and women scented themselves throughout antiquity? Are they, in their natural state, offensive to one another? We may go back to Egypt in the 5th Dynasty and find depictions of women with cones on top of their heads as a mode of perfuming their bodies. At feasts or celebrations of any sort, a cone made of resins and unguents laced with floral extracts was attached to the head so that as the festivities progressed the unguents, salves, and perfumes would melt and run over the body. This caused the wearer to become increasingly alluring. With the earliest of civilizations there was a desire to retreat from natural aromas of the body to more complex and sophisticated scents that are predominantly from plants, scents made from the civet, beaver, deer and whale being notable animal exceptions.

The oldest method of obtaining scents from flowers by extraction techniques is called *enfleurage*. The French are credited with having discovered that flowers gathered at dawn and placed on lard or suet will give their odors over to the fat. The volatile scents are produced in areas in the flower petals known to the botanist as osmophorous glands, and they are lipophilic, which means having a strong affinity for fats, oils or waxes. These were washed from the fat by using alcohol, which was then distilled to achieve an essence that could be used to scent the body. Such primitive techniques are still utilized but have been refined, and each perfumer has endless secret formulas. Some involve over a hundred different natural fragrances, thus justifying the cost of these essences.

Some fragrances are extremely ephemeral and would volatilize minutes after application were it not for a fixative that equalizes the rate of evaporation of the

total ingredients and keeps the relative component scents in a state of equilibrium while they are being worn. The foremost among these fixatives is sandalwood oil, taken from wood chips of *Santalum album*, a parasitic tree found in India, Burma and China. Once used for building because of its disease-resisting wood oils, the trees are now scarce and the oils distilled from them are prized. Even beads made of sandalwood give a lasting fragrance. But more important is the ability of sandalwood oil to stabilize other scents.

Every woman is apprised of the value of henna in imparting an auburn glow to hair. Muhammad is said to have dyed his beard with henna, a dye obtained from leaves of the henna plant, and called it the sweetest flower of both this world and the next. It is the "camphire" in the gardens of Engedi. *Lawsonia inermis*, also known as *Lawsonia henna*, supplied Cleopatra with a delicate perfume that she used with such extravagance that it is said that she perfumed the sails of her barge so that when it entered the Turkish ports all would know that it was Cleopatra. As Shakespeare stated, "so perfumed that the winds were love-sick with them."

The violet has a fragrance so elusive that the wearer quickly loses his ability to detect the scent. It is not the scent itself which fades, but a chemical identified as ionine within the flower that inhibits the sense of smell. By the end of the nineteenth century the demand for essence of *Viola odorata* was so great that synthetics had to be manufactured to meet the demand. The cult of the violet was promulgated by Sarah Bernhardt, who rewrote and recreated for stage the life of Adrienne Lecouvreur. This stage version of the life of an eighteenth-century actress has her die from poisoned violets.

"Violet-absolute" is an essence obtained by macerating violet flowers and extracting them in hot lipids, which are then dissolved away with organic solvents to leave that tiny precious fraction. Few have ever been able to afford this small extraction, and the trade is filled with artificial scents.

The only floral substitute of real merit is derived from the roots of an Indian grass, *Vetiveria zizanioides*. Known in the trade as vetiver or vetivert, it was initially used to moth-proof muslin that was sent from India to England. When Victoria became Empress of India, the scent took on a special significance and a perfume called *mousseline des Indes* was popular among both men and women devoted to the Queen. It was common for men to scent their handkerchiefs with this queenly scent of the Empress. It is now used as a fixative in the same way as oil of sandalwood.

Cedar wood is important not only for

its scent but as a fixative. While a principal ingredient in the perfumes of ancient Egypt, it is little used at the present time. It was one of those important oils used in embalming and surfacing papyrus. Had this not been done, the papyri of ancient Egypt would have been lost to insects and their larvae. The demand for the wood of the Lebanon cedar, *Cedrus libani*, all but destroyed the ancient forests in antiquity. Most trees were used in building, but the chips fell to the unguent maker. The popularity of goats has made it difficult to re-establish these high, upland forests, since the goats ravage the seedlings. The famous "Lebanon cedar wood perfume" of Victoria's time was made with the American juniper, *Juniperus virginiana*. It was obtained from the waste gleaned from pencil makers, and enjoyed great popularity in England as a handkerchief scent. When Madame Bernhardt made her first American tour in 1880, the natives were surprised to find that she regularly carried twelve handkerchiefs each bearing a different scent.

Perception of the natural state of bodily odor has been the subject of many treatises. In the nineteenth century the Germans classified the Nordic blondes as smelling like rancid butter and old leather; redheads (presumably the peoples of Great Britain) smell like rancid butter mixed with catnip (*Nepeta cataria*), and dark types such as brunettes bore the odor of decomposed goats. This peculiar interpretation of scent has a counterpart in the romantic French imagination. Augustin Galopin in 1886 wrote a book entitled *Perfume for Women*, in which he established the natural scent of blondes as amber or violets subtly expressed, redheads have an even stronger odor of amber and violets, while brunettes smell of ebony wood. Galopin found the use of scent as an erotic manifestation used to attract males. More recent scientific studies show that man uses his sense of smell less than any of his other senses. The olfactory cells are comparatively few and are found in the mucous membranes of the nasal passages. A sheepdog has a sense of smell almost one million times more sensitive than that of man. The olfactory cells would appear to be sensitive to the size and shape of molecules passing by them.

Perfumed handkerchiefs were thought to be one way of discouraging bad odors as well as protecting the user from harmful germs. It is true that most essential oils of plants are either bacteriostatic or bacteriocidal, and thus there is merit in such a use. It also harkens to the practice of strewing streets with herbs and flowers when crowds gathered. These produced fine odors but were also thought to discourage the plague. Homes were likewise so strewn when strangers entered. To

allay the fetid breath, cloves were held in the mouth by polite members of the Chinese court during the Han Dynasty (206 B.C. to 220 A.D.), who also held small metallic fan-like breath-guards before their mouth when speaking to one another. The clove, *Caryophyllus aromaticus*, is found in Indonesia and the East Indies from whence it was taken by the French to Mauritius and Zanzibar. It was in use as a perfume in Western civilizations as early as the Middle Ages, during which period it was used as a strewing herb, medicant, meat preservative, plague prophylactic, and worn in hollow jewelry about the neck. The young flower buds are picked and allowed to ferment and dry to give the characteristic odor which mimics that of the carnation, *Dianthus caryophyllus*.

In ancient Rome the bath was a meeting place for washing and conversation, and accommodated thousands at a given time. The waters were infused with the Mediterranean lavender, *Lavendula officinalis*. It was the Romans who introduced the plant into British gardens where the devotion to lavender water became so great that the world knows the scent primarily through the English market. It was a platitude among mothers to say that "it has such a clean smell," thus justifying the use of the essence. The expression is a good one, for the name of the plant and perfume is from the Latin, *lavare*, meaning "to wash." Rome is still indelibly stamped with the fragrance of lavender sold on the streets.

It is incumbent upon the person choosing a perfume or a cologne today to know the base used in making the scent. There is no biological justification for using the extracts from glands of animals that have been killed for these. The colonies of beavers that assemble during the winters in Canada were ruthlessly trapped and killed in order to obtain their fur and the glands from their groins. The dried glands were once a monopoly of the Hudson's Bay Company and were sold as "castoreum." It is an overwhelming odor that was described by a nineteenth-century French perfumer Piesse with contempt: "there are few persons who consider it nice." He might have added, "especially beavers."

Just below the snow line in the Himalayas, the musk deer roams in decreasing numbers. Many were killed at random to obtain the glands that are found just under the skin near the lower abdomen. Only males produce this, and it may be removed by minimal surgery that would leave the animal unharmed, but it is unlikely that animals are going to docilely yield to the probing of these sacs of heavy odor. The historical craze for this fragrance can be traced to its mention in the Koran as that which the true believer

may anticipate in the hereafter. Followers of Muhammad incorporated it into their mosques by adding it to the mortar. The odor permeates all and lasts for many years. Even the dung of a mature male musk deer smells fragrant from musk. It was probably this that led to its discovery. Synthetic musk is readily available and well prepared. There is no reason to trouble the remaining Himalayan deer for their glands. Besides, it is believed that these are important to their courtship, as this is the period of greatest accumulation in the male. To deprive a stag of its natural fragrance may mean that its attraction is lost in competition for females.

The civet is a feline indigenous to Malaysia, Java, Ceylon and Africa. When the Dutch monopolized trade routes at sea, they captured civets and brought them to Amsterdam in small wooden cages. These poor cats were kept in the confines of these cages, so that they were easily manipulated. When angered, the cat produces a secretion from beneath its tail, and the owner collects these exudates with a spoon. While the animal is not mutilated to glean these drops, the cruel and barbarous treatment used to engender the secretion, and the confines of this wild creature, make the notion of wearing such a scent unappealing. It is still used in many perfumes and serves as both scent and fixative. Its popularity in scenting gloves and other articles of clothing was often excessive. The playwright Massinger wrote in the early seventeenth century of the repugnant scent of civet that makes the wooer sick when kissing the hand of his beloved. Concentrate of civet has a fecal scent and does not inspire lust or ardor.

The use of ambergris has always seemed acceptable, since most history books tell us that it is the vomited production of sperm whales that have overindulged in cuttlefish. It is true that lumps of this are occasionally found floating at sea; however, we are not told that as early as the eighteenth century the Dutch discovered that ambergris was the product of the whale's intestine, and that became one of the motives for hunting these endangered mammals. Reason dictates that failure to purchase ambergris-based perfumes is one way to help stop the barbaric slaughter of these great beasts. Keep in mind the unlikely event of coming upon a lump of this precious material floating about in the sea. It is one of the most valuable products obtained from the murdered whale, so that a boycott of the fragrance in favor of floral scents is an important ecological gesture.



One more animal provides a precious base for oils and perfumes, and the use of this animal is so ingenious that as a

biologist I must applaud the use of the goat. Who would dream that an old male goat might provide any odor that was not repugnant in the extreme? In the days of King Solomon goatherds in the south of Arabia allowed their goats to browse upon the thorny shrubs of *Commiphora molmol*, the source of myrrh. As goats feed, they break branchlets of the shrub and the resinous exudates stream down their beards until the hair is encrusted with dried resins. The gracious goat provides not only milk and cheese, but in combing the beard the goatherd is rewarded with one of the great scented resins of history. It is the base of the perfume that the Queen of Sheba used in the tenth century B.C. to perfume her body. When she left the Kingdom of Sheba for a camel ride to Jerusalem to visit with Solomon and his wives and concubines (a thousand in all), she took with her the resins of myrrh from goat beards to present to the great King. In winning his favors she established what has become known as the Incense Road. The demand for both myrrh and frankincense to perfume the temples in Jerusalem kept the Kingdom of Sheba in wealth and protected her from the armies of the Israelites. These resins subsequently found their way into medicine, both internal and external.

The Queen of Sheba also brought with her gums of *Boswellia carterii* and *B. serrata*, native to her homeland. These small trees yield a resin that has had considerable value through history. Sheba was probably that land known to Egyptians in the third millennium B.C. as "the land of Punt." Egypt bought this scented resin for large sums until the fifteenth century B.C., when five ships were sent by Queen Hatshepsut to purchase trees to be planted in Egypt. Under conditions of careful cultivation, they all died, and trade had to be resumed. The Emperor Darius of Persia demanded frankincense for his country in exchange for not attacking Sheba. Solomon continued to buy the plant extract and to protect Sheba's envoys en route.

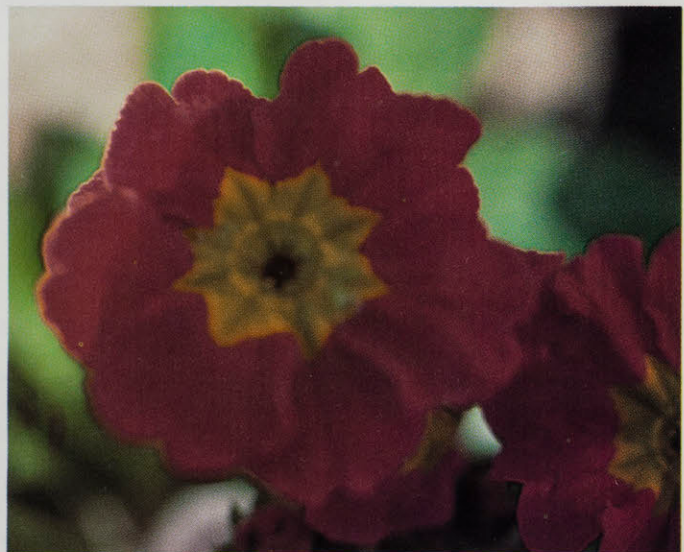
Most ancient civilizations of The Old World used frankincense in temples for ritual purification and the offering up of prayers in the smoke. It was a holy perfume used to anoint the head and brow of the devout.

At the onset of the eighteenth century Paul Feminis, an Italian living in the German city of Cologne, produced a scent to become dubbed "the admirable water of Cologne." The term cologne, now in broad use, had at that time a very specific characterization applying only to that secret distillation produced by Feminis. It was sold under the name *l'eau admirable*, a characterization that it kept for over a hundred years until the formula

Portrait of a woman with perfume bottles.



The musk rose is used in preparing "attar of rose."



Primula hybrid wild primroses were the source of a delicate perfume.

Louis XIV, the most perfumed monarch in history.



was altered. The original was based upon the oil of the Italian *bergamotto*. This rare citrus found in the toe of Italy's boot yields a sparse amount of oil from its pungent rind. Mixed with other citrus fragrances and lavender, it was the very winds of the south of Italy that northern peoples have always yearned for. It quickly replaced the former major scent, "Hungary water," a rose water of great popularity. *Citrus bergamia* is almost as rare now as in the eighteenth century and certainly more costly. When the famous water of Cologne passed into the hands of Jean Marie Farina in the nineteenth century, the formula was changed to include rosemary (*Rosmarinus*), abundant in southern Italy. This new exotic elixir was dubbed *eau de Cologne*. Its popularity spread so rapidly, and chemical analyses were so advanced, that in a few years *eau de Cologne* was made by every perfumer, but no two were the same. Pierre Guerlin was wise enough to introduce it into the court of Empress Eugenie during the reign of Napoleon III. Of course, he gave his perfume the name *eau de Cologne Imperiale*. Terminology became relegated to concentration, toilet water being more diluted than perfume, and cologne the lightest fraction and least concentrated. All bear the same scent when marketed under a given name.

16 One of the scandals of the nineteenth century was that as colognes became more available and scents were able to be cheaply synthesized, domestics and shop girls were able to perfume themselves. The overwhelming cheap scents that always loiter instead of linger were obtrusive. Ladies of the house had to issue orders that if fragrances were to be worn, they would have to be subdued and not interfere with aromas worn by the mistress of the manse.

Elizabeth I had started much of the English craze for perfumes with her own peculiar distillations and formulas. She insisted that all in court about her wear scents of her choosing. The necessity of this is apparent when one considers that the clothing was rarely changed and bathing was thought dangerous, as it "opened the pores to disease." Elizabeth scented her gloves, shoes, clothing, body and the appointments about her. She had studied the apothecaries' art and was not unskilled in compounding her own astonishing fragrances. These were no doubt used in part to conceal the pungent smell of vinegar and white lead mixture that she used as a facial cosmetic to cover a poor complexion.

It is believed that the Greeks acquired the habit of perfuming themselves from the Syrians and Egyptians. Banquets were distinguished by oils, gums and resins rubbed on the bodies of participants as well as on the statuary. Greek men wore

lighter perfumes than those of their women and were distinguished more by herbal essences than the musks of the female perfumes. While these odors met with a rather general acceptance in civilized Greece, there were men who spoke out against the practice of scenting. Socrates proclaimed that men should smell only of their labor and manly exercise. Which translates out of the Greek as "sweat."

Rome drew upon Greek customs of scenting, and as with most derived traditions, they exaggerated every aspect extending it to pets, work horses and hidden sprays in rooms. Nero had a plumbing system for scents in his ivory ceiling, and guests were sprinkled with blossoms that had been scented with perfumes. Perfumed doves flew about his court. Perhaps this is the original gilding of the lily. Roman troops took perfumes and cosmetics into battle, a custom that offended Julius Caesar but few others.

Europe might have lost the perfumer's art in the post-Roman era, as Christianity had no use for such excesses of worldly display. The Arab world not only kept learning alive during the Dark Ages, but kept a balance with respect to worldly pleasures. Rooms were washed with rose water, and it was used to scent carpets. Even mosques were cleaned with rose water. The cult of cleanliness and perfuming was restored to Europe during the Crusades. Levantine baths were built in Europe, and floral waters as well as exotic scents of musk were reestablished. Curiously, men seemed to prefer rose water, taking it as a manly smell. This was probably because they had done battle with men who were strong of limb and wondrously scented.

Until the beginning of the eighteenth century, most Europeans used baths infrequently and perfumes were used to cover unpleasant body odors. Perfumed public baths were occasional social rituals and not daily observances. The church succeeded in closing many of the baths, and the notion that "cleanliness is next to godliness" was a late conceit. Tudor England retained baths and scents when much of the rest of Europe was wallowing in the stench of the streets and of unbathed and unperfumed bodies. Not that the Tudors were clean, for they rarely bathed, but they did perfume their clothes, shoes, gloves, heads and less often the unexposed parts of their bodies. Bowls of rose water were kept about the houses, and casting bottles, much like salt shakers, were kept about so that a guest might anoint himself with exotic floral fragrances. The pomander, now relegated to closets, was carried by both men and women. The Puritans finally put an end to all of the flowery dreams of England.

European courts kept the tradition of scenting alive in the royal households and palaces, despite the general condition of the unwashed masses. Scented and painted males dominated these courts and neither condition was considered unmanly. Louis XIV, the Sun King, had the distinction of being called the most fragrant monarch in the history of the world. He had exclusive perfumes, some to anoint his body and others to be used in washing his clothing. The odors were floral and the formulas included only a few grains of musk.

The protective nature of scents was widely believed. Not only would they put off the plague, but they were certain healers of wounds. Men still use bay rum as both a scent and an antiseptic wash. The eighteenth century saw the use of perfumes as mouthwashes and even internal medication. *Eau de Cologne* was mixed with brandy and drunk for hangovers. The antiseptic nature of most perfumes is an established fact, but the potability is highly questionable. Many perfumes and colognes would be toxic if drunk.

The complexity of American life as it relates to scent is beyond all explanation. As a generalization, the Europeans brought with them their traditional scents. Puritan tradition in this country was never accepting of such notions, and as a generalization it has been considered unmanly, if not foppish, for a male to scent himself. The splash of citrus-based after-shave lotion became the cover for men perfuming themselves. Women had experienced a renaissance of scents in the late nineteenth century, but their men were not permitted such excesses. The American male could have scented water doused on him by a barber to use some of the lilac water for which he had a secret passion. Nondescript names like Florida Water seemed safe enough.

Deodorants for men did not appear until well after the Second World War and were still in question in the 1950's. The last two decades have seen an enormous proliferation in the scents used by men to their delight and to the relief of their ladies. Women have in turn explored the wider use of scents as they were once employed. Navel cups of perfume were popular in ancient world and anointing the breasts was commonplace.

Today's perfume industry has available to it over four thousand scents, to include natural and artificial, that may be employed in concocting a specific scent. Many scents have a limited popularity, but some have been preserved for hundreds of years. For not too great a sum, you may indulge yourself in an eighteenth-century formula of cologne, or wear the fragrance of Empress Eugenie. Attar of rose or violet absoloute of the finest class may cost the perfumer in excess of five

thousand dollars per kilogram. If that seems extravagant, consider that it requires approximately two tons of small Persian rose petals to produce one pound of attar of rose, the very essence of the flower's fragrance. The fragrance of roses may be achieved by synthetic means for a small sum and in large quantities, but like unaged, filtered wines, they will never satisfy the connoisseur.

Who would substitute a chemically synthesized aldehyde rose or violet scent for flowers picked by hand and spices ground by hand in china mortars?

Cultivated tastes are not restricted to the palate. Despite our olfactory limitations, we are attuned to scents of great complication that come to us like fugues in music, and their counterpoint delights. One protracted note has never been considered music, and one scent does not a perfume make. While the chemistry of the body may give a scent subtle shades of meaning, a kind of tonality, it does not substitute for complexities built into a perfume. Fragrances of particular flowers in nature are not simple, thus a synthetic base for an aroma is a poor mimic of the true floral or herbal scent. Rarely does a perfume bearing the name of a single flower carry only that scent. Perfumers compound a pervasive odor with others to produce a fragrance that cannot be duplicated and that will sustain itself. The many thousands of scents in nature that have been captured by the perfumer are only a part of his repertoire. Beyond this are the created scents that have not existed in nature.

There is no simple account of perfumery, for it has filled encyclopedias. As early as 1680 an entire book was given over to an account of the origins and uses of perfumes (*Le Parfumeur François*). Perfume is as much a mark of civilization as any other cultivated and educated taste. The plant kingdom provides us with enough sources for these aromas that we need not trouble the civet, deer, whale or beaver for scents to please.

William Emboden, frequent contributor to Terra, has distinguished himself in the field of ethnobotany and most recently has shed new light on the role of the water lily in Egyptian and Mayan glyphs.



Bunch of Violets Containing the Silhouettes of Napoleon I, Empress Louise and the King of Rome. Picture Card Circulated in France, 1815.

Parfum Violettes du Czar. A perfume of 1898 implicating The Russian monarchy.



PARFUMS VIOLETTES DU CZAR
 aux **ESSENCE** pour **POUDRE**
LE MOUCHOIR de RIZ
SAVON

Création de la **PARFUMERIE ORIZA** de **L. LEGRAND**
 11, Place de la Madeleine, PARIS.

THE GREAT-BILLED TOUCANS

by Alexander F. Skutch

Illustrations by Dana Gardner

Birds, like men, achieve fame for the most diverse reasons. Many people who have never heard of trogons, jacamars, guans, and many another notable bird family of tropical America, would recognize hummingbirds and toucans, which they may have seen in pictures or zoos, if not

in their natural habitats. Yet it is difficult to imagine two bird families that contrast more strongly. Hummingbirds, which include the smallest of feathered creatures, are dainty, slender-billed, superb masters of flight, and essentially solitary. Toucans are heavy-bodied, mediocre flyers, gregarious, and have the bulkiest bills of all the woodland birds of tropical America. One seeing these bills naturally asks why

are they so enormous and highly-colored. How does it help the toucans to survive? To answer these questions, we must consider how toucans live.

The approximately forty species of the Ramphastidae or toucan family are distributed through the forests and savannas of tropical America, from southern Mexico to Paraguay and northern Argentina, excluding the West Indies. Despite

their very different appearance, toucans are related to woodpeckers: like them, they have two toes directed forward and two backward; their structure and life histories are very similar. The largest, heaviest bodied of the toucans, with the most exaggerated bills, are classified in the genus *Ramphastos*, with a dozen species. Their plumage is largely black, with a contrasting patch of yellow or

white covering the cheeks, throat, and chest, white or red upper tail coverts, and red beneath the tail. This genus contains the Toco Toucan, whose enormous bill, orange-crimson, greenish yellow, and black, accounts for eight of its twenty-six inches in total length. Most of these big toucans have highly-colored bills, but that of the Keel-billed Toucan is the most beautiful, with six colors so delicately

blended that it might be called the Rainbow-billed Toucan. The flight of these heavy-bodied toucans is characteristic: after a number of rapid wingbeats, they close their wings and appear to be borne downward by their great, forward-pointing bills. By immediately spreading their wings, they convert their fall into a downward glide, which is followed by a new series of flaps that recov-

Crimson-rumped Toucanet



Yellow-eared Toucanet



Stripe-billed Aracari



ers lost altitude. Thus the toucan traces an undulatory course from tree to tree.

Intermediate in size are the thirteen species of *Pteroglossus*, known as aracarís, whose more slender bodies are more variously colored with black, red, yellow, green, and chestnut or maroon. Their bills, more slender than those of *Ramphastos*, are long in proportion to the birds' size and colored in the most diverse patterns. Aracarís are more agile than the larger toucans; their swift, direct flight appears less labored and probably accounts for their survival in disturbed woodlands from which *Ramphastos* disappears.

Ramphastos and *Pteroglossus* inhabit warm lowland forests and are rarely found more than five thousand feet above sea level. The seven species of toucanets of the genus *Aulacorhynchus* prefer cool mountain heights, but their altitudinal ranges often overlap those of their larger relatives. The predominantly green plumage of these small toucans is relieved by patches of chestnut, blue, yellow, red, or white. Although rarely dull, their large bills tend to be less spectacularly colored than those of the bigger toucans.

Less well known are the four species of mountain-toucans of the genus *Andigena*, which range from subtropical forests high into the Andes and have highly variegated plumage and bills, and the four species of toucanets of the genus *Selenidera* of low and medium altitudes. These last are the only toucans of which the sexes differ in coloration. The bills of male toucans are generally longer than those of females, and in some mated pairs the difference is great enough to distinguish the sexes in the field.

The great bills of toucans are not as heavy as they appear. The thin, horny shell that bears the bright colors encloses a hollow space crisscrossed by slender, bony struts and braces that impart rigidity with a minimum of weight. Nevertheless, toucans must be careful not to use their bills too roughly, for sometimes they are broken. A Chestnut-mandibled Toucan lacking the terminal inch or two of its upper mandible somehow managed to stay alive and apparently well-nourished, in the wild, for at least two-and-a-half years. I always saw this easily recognized bird alone; but another, with half its lower mandible broken off, so that much of its tongue was visible from afar through binoculars, was accompanied by a mate, who possibly fed it. Seven weeks after I first noticed this injured toucan, it appeared to be in sound health.

Toucans are sociable birds that travel in groups, usually of no more than six or seven individuals, rarely a dozen. Unlike blackbirds, shorebirds, and many other birds that

take wing together, as though moved by a common impulse, and fly in compact flocks, toucans are more individualistic. First one member of the group flies off, while the others delay, as though trying to decide whether to follow. Then a second starts in the same direction, and, after a while, a third. Thus they straggle along from tree to tree, through the upper levels of the forest or clearings with scattered trees.

Toucans not infrequently indulge in a social activity that I have never seen in birds with smaller bills. Last year I watched a party of Fiery-billed Aracarís in the tops of some tall, slender trees beside the river in front of our house in Costa Rica. They flew back and forth, then two of them grasped each other's bills, pushed, and separated. Next, one of these took on another opponent, and this continued until most of them seemed to have pushed together. Each encounter lasted only a few seconds. As far as I could tell with so much shifting around, no one tried to dominate the others; they appeared to be in a playful mood. On another occasion, two of these aracarís struck their long, red bills together, like fencers crossing swords, before they grasped and shoved. This time, the contest continued until one was forced backward and hung below the branch. Then it flew away, admitting defeat. Promptly another aracarí advanced to challenge the victor. They struck bills together, clinched, and pushed until the newcomer remained as undisputed champion. Again, no aggressive pursuits followed these playful encounters, which have been witnessed in several species of toucans.

After one of these wrestling matches, an aracarí rested on a high branch with head bent down, while another preened or nibbled the feathers of its nape. Such care for their companions' plumage is widespread among toucans. One morning before sunrise, in the heavy Caribbean rain forest of Costa Rica, I watched a pair of Chestnut-mandibled Toucans alight in the top of a huge leafless tree, where several pairs of Mealy Parrots were giving unrestrained play to strong, raucous voices. One of the toucans held in the tip of his great bill a fruit that he passed to his companion. This was followed by four or five other items produced from his throat or perhaps deeper regions. After accepting all these gifts, the recipient gently preened the donor's throat and neck with the tip of her bill. Sometimes two Chestnut-mandibled Toucans alternately preen each other's plumage, perching so far apart that they seem to fear each other, but the separation is made necessary by the length of their bills.

I have seen toucans bathe only in aerial pools, such as a water-filled hollow in a

crotch or a cavity in the upper side of a stout horizontal branch of some great forest tree. The members of a pair or flock take turns splashing in the high bathtub, then emerge to preen, scratch, and arrange their plumage in a spot of sunshine amid the foliage.

Where not persecuted, toucans are sometimes unmistakably curious about man's activities. Years ago, while I collected botanical specimens beside a rivulet flowing through mountain forest where few people came, a party of Chestnut-mandibled Toucans flew about in the treetops. Presently, two of them descended to perch no more than five yards above me. Head and great bill cocked to one side, a toucan watched, with a large brown eye set amid pale green bare skin in a yellow face, while I arranged ferns between the papers of my plant press. The companion of this inquisitive bird soon became more interested in the fruit of a forest tree, which it held beneath a foot while pulling it apart with the hooked tip of its bill.

Long familiarity with toucans in their native forests has convinced me that their extraordinary bills are worn by birds of extraordinary character. With their angular bodies and movements that often appear clumsy, their far from melodious, often croaking voices, and their playfulness, they remind me of feathered clowns. What a contrast between these restless, excitable toucans and their neighbors in the tropical American forests, the staid, dignified, usually mellow-voiced trogons, clad in the elegant plumage that befits such gentlemanly birds!

Toucans are largely frugivorous, eating a great variety of the fleshy fruits of forest trees and soft, nutritious arils that surround hard, indigestible seeds. Too inexperienced on the wing to snatch fruit in flight as trogons, manakins, and many other birds do, too heavy to cling near the slender tips of the twigs that bear these fruits, the toucan perches farther in, where the supporting branch is stronger, and stretches out to pluck a fruit or seed in the tip of its long bill. Then, with an upward toss of its head, it throws the article back into its throat and swallows it. Toucans vary their diet with such insects as they can catch. When termites release their winged sexual brood, providing a feast for the whole avian community, toucans manage to catch some of the slowly fluttering, soft-bodied insects that fill the air around them.

No one who watches a toucan plucking berries can doubt that its great bill is serviceable to it. Nevertheless, this observation furnishes only a partial answer to the problem of the toucan's bill. It tells us why the bill is long, but not why it is so bulky and highly colored. A slender,

dull-colored bill of the same length would be equally efficient for gathering fruits.

Toucans, including the big *Ramphastos*, the middle-sized aracarís, and the little green toucanets, occasionally take eggs or nestlings from the nests of other birds, mostly smaller than themselves. While they stand beside a nest, plundering it, I have never seen an outraged parent, not even the biggest and boldest of the "tyrant" flycatchers, dare to attack them. A friend even watched a toucan swallow an egg of a small hawk, after driving the female from her nest. Those huge, menacing beaks effectively hold angry parents at bay.

Here we have a clue to the high coloration of toucans' bills. Bright colors make friendly things more attractive, but they make hostile things appear more formidable. Men of many races have painted or gaudily attired their bodies not only for their festivities and wooing but also to confront their enemies in battle; bright hues serve as the "warning coloration" of unpalatable or effectively protected animals as well as in courtship. Doubtless, the conspicuous colors of toucans' beaks make parent birds less ready to attack these plunderers. But when the toucan flies and cannot turn his head to defend his back, kingbirds and other large flycatchers harry and sometimes buffet him. Nesting Boat-billed Flycatchers may fly a long way to harass an approaching toucan.

Although it is sometimes stated that toucans sleep in cavities in trees, neither from personal observation nor search of the literature have I found any evidence that this is true, except for the aracarís. As I and others have repeatedly seen in several species of these middle-sized toucans, at nightfall they enter a hole carved by one of the larger woodpeckers, or sometimes one resulting from decay. Up to five or six may crowd into the same high hole, or a large party may divide up between two neighboring holes. Often they appear to have several available dormitories; if alarmed when about to retire into one, as by too-obvious watching, they fly off to another. Aracarís' bills appear to be inconveniently long for a crowded dormitory, but these birds have solved the difficulty. As the last aracarí pushes into a bedroom already packed with his companions, one may see him tilt his tail forward and lay it along his back to save space. His bill is also laid upon his back, beneath his tail, converting a body with long, projecting extremities into a rotund mass of outfluffed plumage. Larger toucans also fold themselves up in this manner when they roost amid the foliage of trees.

Birds that nest in holes but cannot carve them often covet the aracarís' dormitories. One of these is the Masked Tit-

yra, a starling-sized bird of the forest treetops. Too timid to attack the much bigger aracarís, the female tityra proceeds in a more subtle fashion to evict them. During the day, when they are out of sight, she carries dead leaves and twigs into their hole. Each evening, when they return, they find less room in their dormitory. Finally, feeling too crowded, they abandon it, and the tityra moves in, to lay her eggs and raise her brood.

Sometimes the most obvious difference in the appearance of two species of toucans that inhabit the same forest is in the colors of their bills. Bill coloration, in addition to differences in voice, probably helps toucans to recognize members of their own species and prevent mismatching. The conspicuously and often beautifully colored bills may also enter into courtship displays; but, as is true of many tropical birds that form enduring pairs, we know little about how these pairs originate.

As far as we know, all toucans nest in holes in trees but are unable to make them. Once, indeed, I watched a pair of Blue-throated Toucanets trying to carve into a decaying trunk, pecking so hard that I could hear them a hundred feet away; but the undertaking proved too difficult and was soon abandoned. The smaller toucans often breed in holes made by the larger woodpeckers, or sometimes in one made by a small woodpecker, if the surrounding wood is soft enough for them to enlarge it. The big *Ramphastos* toucans appear always to occupy a cavity made by decay, which may be shallow or several feet deep. The nest may be very high, but sometimes, probably because no loftier hole is available, it is within hand-reach of the ground, where toucans are rarely seen. No toucan is known to line its nest cavity, the bottom of which is soon covered by seeds of many shapes and colors that the parents have regurgitated after digesting the surrounding flesh. On this pebbly bed rest the two to four pure white eggs.

Nothing so well reveals the restless, mercurial, suspicious temperament of the toucan as its manner of incubating. In forests where many sparrow-sized birds sit on their eggs for several hours continuously, and male trogons and pigeons incubate without intermission through most of the day, toucans don't usually remain at their task for as long as an hour, and almost never as much as two hours. The male and female take turns on the eggs, but often one leaves before the other arrives to replace it. The same bird may leave and return to the nest several times during its period of duty, sometimes after sitting for only a few minutes. Thus, despite the cooperation of both parents, the eggs are commonly left unwarmed for from twenty to thirty percent of the day-

time. Although I have watched toucanets and aracarís attend their nests while I stood or sat unconcealed, usually at a good distance, the big *Ramphastos* toucans are often so suspicious that they are difficult to watch even from a camouflaged blind. Either sex may incubate or brood nestlings through the night. I found the female of a pair of Blue-throated Toucanets in Costa Rica taking charge by night; but at a nest of Red-billed Toucans in Guyana, Godfrey R. Bourne discovered that the male usually did so. In woodpeckers, to find the female caring for the eggs or nestlings by night is most unusual.

After about sixteen days of incubation, the nestlings hatch. Blind, prognathous, with no trace of down on their pink skins, they are grotesque little creatures. The lower mandible of the short bill is broader as well as longer than the upper mandible, which bears at its end the white egg-tooth that helps the little bird to break out of the shell. Each heel is covered with a pad of thick skin studded around the edge with tiny spikes, a development that protects this joint from abrasion as the nestling shuffles around on its pebbly bed, supporting itself on its heels and posterior end. From the day they hatch, these nestlings make a sharp, squeaky buzz while one looks in at them. The parents promptly remove the empty shells.

During the nestlings' first week or two, the two parents brood them by turns, and both bring them food. Often the adults arrive with one item in the tip of the bill, others inside the mouth or throat, to be brought up as the young are fed. After the first few days, the nestlings' diet consists mainly of fruits and arillate seeds, varied by an occasional mature insect, caterpillar, lizard, or nestling of some other bird. The surprisingly large size of some of the fruits sometimes causes amusing incidents. Once, in the Costa Rican highlands, I watched a Blue-throated Toucanet enter its nest hole, holding in its bill a big, one-seeded fruit of a tree of the laurel family. After a minute or so, the parent tried to emerge but stuck in the narrow doorway. In vain it pushed and squirmed; it seemed trapped within. Finally, it found a solution to its problem. It regurgitated the fruit that it had evidently swallowed when the nestlings were unable to do so, and, with reduced girth, passed through the orifice holding the object in its bill. While I examined a Rainbow-billed Toucan nest, a parent, perched high above me, nervously swallowed and regurgitated the same seed many times over, or restlessly shifted an insect between its bill and a foot.

Although toucans have complained loudly while I looked into their nests, none has ever attacked, or even darted at

me with clacking bill, as many a smaller bird has done. One might suppose that a bird with such a beak, ensconced in a chamber with solid walls and a narrow doorway, could repel snakes and small, predatory mammals. Nevertheless, as far as I have seen, toucans hasten to escape from their holes at the first suggestion of danger, whether from man or some other creature, leaving eggs or young to their fate. As with other birds of tropical forests, most of their nests are destroyed by predators.

At intervals, parent toucans remove large billfuls of waste, keeping their nests clean.

Nestling toucans develop very slowly. Until they are nearly a month old, they do not keep their eyes open when one illuminates their nest with a small electric bulb and looks in with a mirror. They take more than a month to become decently clad with feathers. The smaller toucans remain in their nests at least six weeks, the larger ones a week longer. When they finally emerge, they rather closely resemble their parents in plumage, but their bills are smaller and paler.

As darkness fell over the Panamanian

rain forest on an evening in February long ago, I watched six Collared Aracaris squeeze through a narrow opening on the underside of a stout horizontal limb, a hundred feet up in a great tree, to enter the hollow where they slept. By the end of March, only a single aracari slept in this cavity. Now, whenever I clapped my hands loudly in the daytime, a great pied bill was thrust through the orifice, and a slender, long-tailed body laboriously followed it out, to fly away through the forest. Even so inaccessibly high, the aracari felt insecure in the hollow where it was evidently attending eggs. By early April, four of the five aracaris who had gone to roost elsewhere while incubation was in progress had returned to sleep with the nestlings. Continued watching revealed that the young, of which there were at least three, were fed by five grown birds. As I interpreted the situation, the parents had three helpers, who were probably their offspring of earlier years, and, accordingly, older siblings of the nestlings that they attended.

Although such family cohesiveness is not rare among jays, bee-eaters, wrens, and other birds permanently resident in

mild climates, nest helpers have not been found in other species of toucans, not even in the closely related Fiery-billed Aracari, of which I have watched several nests. Over the years, I have searched fruitlessly for a second nest of the Collared Aracari, and nobody else appears to have found and studied one. We still do not know whether the situation that I found at the high nest in Panama is usual or exceptional in this species. So much remains to be learned about the habits of birds that yearly become rarer as the tropical American forests shrink before man's relentless inroads!

To return to our opening question: Why do toucans have such huge, highly colored bills? The bills's length enables these birds to reach fruits on slender twigs while they perch far enough inward to find support for their heavy bodies. Its bulk and vivid coloration intimidate parents whose nests they pillage. It may help to prevent mismating by associated species that differ most conspicuously in the colors of their bills, and it may also play a part in courtship. Of rather fragile construction, the bill is definitely not a weapon of defense.

Dr. Alexander F. Skutch has spent a lifetime studying the natural history of the neotropics. He is the author of numerous articles and several books and is the leading student of birds in the tropical forests.

Dana Gardner spent five years painting tropical American birds. He currently is staff artist for the Western Foundation of Vertebrate Zoology, Los Angeles.

SCIENTIFIC NAMES OF BIRDS MENTIONED

(in the order of their occurrence)

- Toco Toucan
Ramphastos toco
- Keel-billed or Rainbow-billed Toucan
Ramphastos sulfuratus
- Chestnut-mandibled Toucan
Ramphastos swainsonii
- Fiery-billed Aracari
Pteroglossus frantzii
- Mealy Parrot
Amazona farinosa
- Boat-billed Flycatcher
Megarhynchus pitangua
- Masked Tityra
Tityra semifasciata
- Blue-throated Toucanet
Aulacorhynchus caeruleogularis
- Red-billed Toucan
Ramphastos tucanus
- Collared Aracari
Pteroglossus torquatus



Black-billed Mountain Toucan

Keel-billed Toucan



DANA GARDNER

What is a truffle? Most simply, truffles may be thought of as underground mushrooms. They are tuberous masses comprised of fungal tissue containing spores. They are sought after by the great chefs of the world for the unique flavor they impart to food and sauces. The young truffles are bland, while the older fruit is in its gastronomic prime.

As to particular characteristics of the truffle, Dr. Clark T. Rogerson, mycologist at the New York Botanical Garden, provides the following description:

In size, truffles range all the way from that of a small pea to that of a small lemon; perhaps hazelnut and hen's egg would define the commoner variation; in color from white through buffy shell pink, chestnut brown and chocolate to shiny jet black; in texture from the fleshiness of a cultivated mushroom to the firmness of a Brazil nut.

These underground fruit-bodies are produced on mycelium, the vegetative part of the truffle fungus that is initiated from germinated spores.

Truffles are dependent on animals for spore dispersal. For example, a small mouse called the California red-backed vole eats mostly truffles; it tunnels around in the ground eating its way from one truffle to another. In this case, as in that of other truffle scavengers of the forest such as deer, mice, squirrels and pack rats, the consumed truffle tissue is digested, but the spores go through the animal's system unscathed.

With the deposition and germination of spores in the proper forest niche, the truffle mycelium grows and penetrates the soil for several yards. Some parts touch and penetrate the roots of a favored tree along the way. The resulting nutritional partnership is mutually beneficial—even necessary—to both plant and fungus. The truffle fungus transfers food derived from the root association to other remote parts of the mycelial system throughout the forest soil where eventually the truffles are produced. The life cycle of the truffle fruit-body with spores, then spore dispersal and germination, followed by mycelial development, and then the truffle fruit-body—will go on and on *ad delictum*.

Truffles impart such subtle and special flavor that Los Angelenos pay around \$500 per pound for the imported black truffle, and the white truffle freshly flown

in from abroad reportedly goes for \$400 per pound. While those of us in California may not have truffles at the bottom of our gardens, we may be closer to these delectable fungi than one would think. Consider the fact that northern California has the same calcium and limestone soil, the same rolling terrain and the same moist climate as do those sections of France and Italy where truffles grow. And there are similar pastoral settings complete with oak groves and even charming little towns; moreover, the latitude is about the same.

Why, then, don't we have a West Coast truffle industry? There are eighty known species of truffles native to the Pacific states. Many grow in California, and new ones are still being discovered. A number are good to eat, and some with exceptional flavor are likely candidates for commercial cultivation. And, great news for the gourmet, they are presently being researched with just that goal in mind. Until now, except for ardent mycologists (whose full-time job it is to study fungi), there hasn't been much interest in researching truffles.

Reports on truffle cultivation research will be forthcoming soon from a laboratory in Oregon, and also from France where an International Symposium on Food and Science is to be held. In this country, there will also be reports on genetics as applied to developing truffles of ideal odor and flavor. Despite these encouraging early developments, it is likely to be some time before the entire population of the United States succumbs *en masse* to Trufflemania.

France vs. Italy

The route to understanding potential California cultivation of truffles clearly begins in Europe where there are but two truffles which have maintained a steadily increasing international vogue. One, the most widely-known and appreciated of all truffles, is *Tuber melanosporum*, known as the "black truffle." It is found most abundantly in a southwestern section of France called Perigord, where both wild and cultivated types are marketed.

One of the major market centers is the town of Cahors where, not so incidentally, there is also a goose market. This juxtaposition of goodies eventually led to a form of dementia in France. Some ingenious persons conceived the idea of making *Tuber melanosporum* the black nugget at the heart of a mass of

homogenized goose livers...there was of course no turning back. A French farce of the nineteenth century serves to illustrate the point. There is a scene wherein an ecstatic bourgeois—having dined on *pâté de foie gras* with truffles—hopefully enquires of the *maitre d'hôtel* as to whether each subsequent dish is to be "with truffles?" True, the play is a farce and the diner *bourgeois*, but when one considers that *Tuber melanosporum* combines in one rich particle both the savor of a filbert and of a properly matured cheese...possibilities enflame even the most sophisticated mind. One sober botanist has described this truffle as being swathed in the effluvium of strawberries. Dare one speculate as to the desirability of truffled *gâteau à la crème*?

Tuber melanosporum is found in Italy as well, particularly in the province of Norcia where it is not illogically known as the black Norcin Truffle. It is in no way, either macro- or microscopically distinguishable from the Perigord truffle of France. There is, however, a difference between the Italians and the French. The former insist that the Norcia truffle has the best flavor and aroma; the latter make the same claim of the Perigord truffle...or is that a difference?

The other highly-prized truffle is found only in Italy, most commonly near the old market town of Alba in the Langhe hills about twenty-five miles south of Turin. In 1788, Vittorio Pico of Turin described the *tartufo bianco* and gave it the name it continues to carry, *Tuber magnatum*. This white truffle has since become known and appreciated in other countries, and today is spoken of by the initiated with a kind of religious fervor. Like black truffles, *Tuber magnatum* has both the flavor and aroma of filberts and cheese, but with an important plus...garlic! This combination makes for something so overwhelmingly pungent that any attempts to describe the white truffle must fall short. It is enough to know that just one truffle will deliciously flavor an entire crate of eggs intact in their shells.

Think, then, how many more individuals would ascend to Truffle Nirvana were they able to dine copiously on *Tuber californicum*. Yes, such a truffle does exist. It grows in northern California, and was first studied in some depth at the turn of this century by Dr. Harvey Harkness of the California Academy of Sciences in San Francisco. He described it as being almost identical in aroma, flavor and appearance to the celebrated Italian

Truffles...or Trauma

white truffle. Although the Harkness research reports went up in flames following the San Francisco quake of 1906, much of his data was published and current research bodes well for the future of this truffle...seemingly a kind of *Tuber phoenixium*.

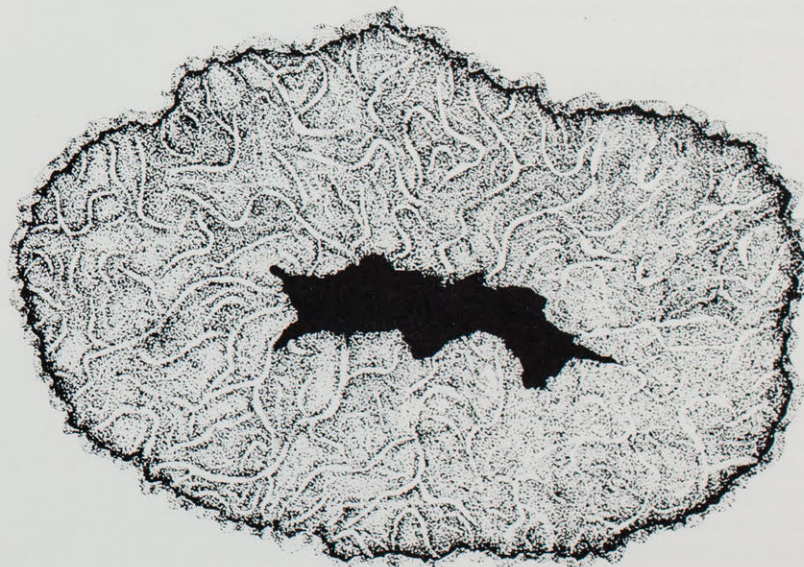
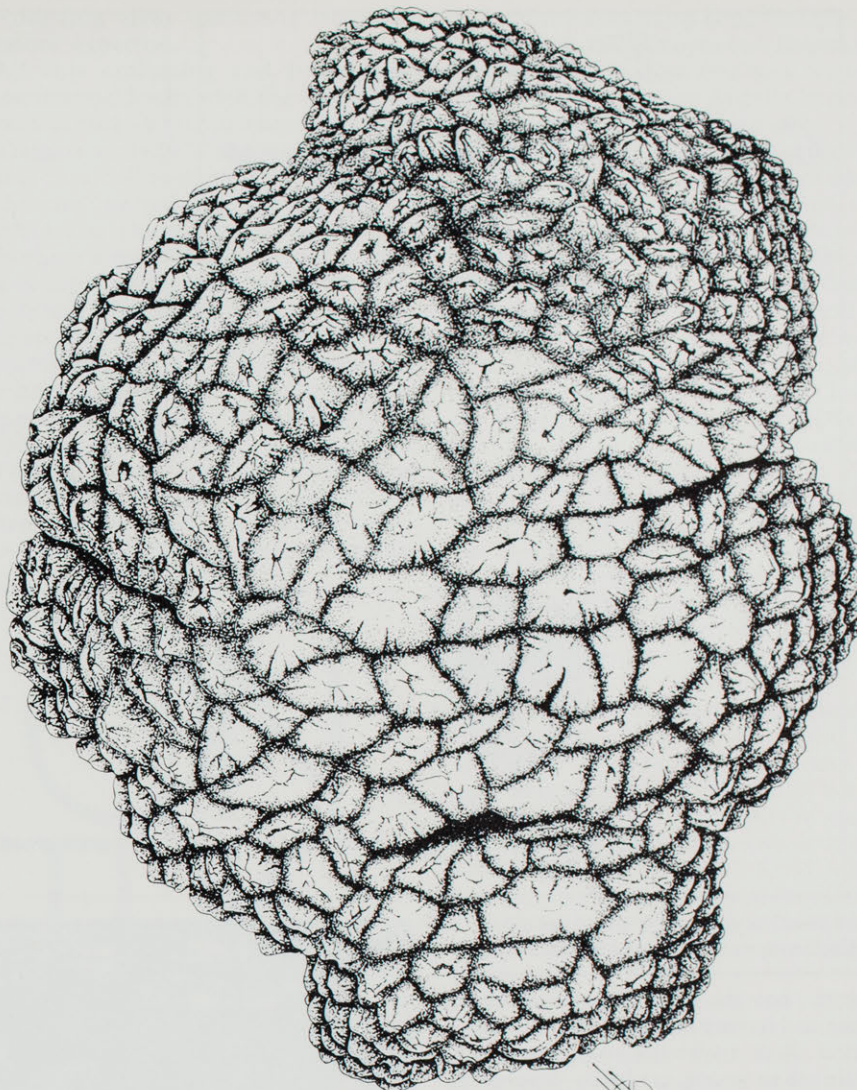
California Industry Organizers

A number of individuals in this country believe that a California truffle industry might be formulated in the near future. One such man is Dr. James M. Trappe, the principal mycologist at the U.S. Forest Service Forestry Sciences Laboratory in Corvallis, Oregon. In the last twelve years, he has become the world expert on truffles. In 1975 two semi-retired Santa Rosa bankers, J. Ralph Stone and Henry Trione (pronounced "tree-oh'knee"), formed a corporation known as Tristo Limited, dedicated to finding and selling native American truffles. These two entrepreneurs also contribute support to certain research with the cultivation of imported European truffles on the west coast. Bankers Stone and Trione are currently subsidizing research at Oregon State University for a three-year research project to be concluded before the end of this year. At that time, formal proposals will be made as to the feasibility of instigating a California truffle industry. Others involved in affiliated mycological research may be reporting in as well. Those making up this link between scientific and commercial goals are optimistic as to the future. Dr. Trappe, for one, speaks enthusiastically of the alliance, hoping it will stimulate more research on commercial truffle culture by university scientists.

Another stimulus for a closer alliance between commerce and academia is the fact that the world's marketable truffle supply has for years been dwindling, while the demand has steadily increased. Unfortunately, after both World War I and II, entire plantations of oak were ruthlessly cut down in France and in Italy with vineyards established in their stead. Since the common European oak, *Quercus pubescens*, is one of the truffles' preferred tree associates, it is easy to understand the consequences of such destruction.

It is Dr. Trappe's opinion that the most promising native truffle candidate for commercial cultivation in California is *Tuber gibbosum*. This fungus is native to the Pacific states and grows abundantly in Oregon and California at still higher elevations.

The preferred tree associate for *Tuber gibbosum*, the Douglas fir, has a similar occurrence. *Tuber gibbosum*, says Dr.



The black truffle, *Tuber melanosporum*. The outside surface of the subterranean fruit body appears rough while the hollow inside is

lined with a thick spore-bearing tissue which is the source of the flavor.

First Annual California Truffle Congress

November 7, 1975

Santa Rosa, California



Tristo Ltd.

Menu

CONSOMMÉ de FAISAN TRUFFÉ
à la façon de Claus

FETTUCHINI "ALBA"
aux truffes blanches de Alba

COEUR DE CELLE d'AGNEAU GRILLÉ
Sauce Périgourdine

L'Epinard en branche au beurre
Coeur de Palm Amandine

SABAYON

CAFÉ

26

Pages from the menu of Tristo Company
Truffle Conference banquet held in California.

Trappe, "has the double virtue of being edible and having an important tree association. It is a whitish and pale yellow truffle when young, gradually developing reddish brown patches which eventually spread over the whole fruit. As to flavor and aroma, it is very close to the garlicky *Tuber magnatum*."

Progress

How might commercial cultivation of truffles proceed in California? (One hopes...not too slowly.) Past methods won't do. In France and Italy the indirect method (i.e. waiting for nature) has been used for over 160 years. This is simply to disseminate acorns from known truffle-associated oaks to other ground, and to wait for a truffle oak plantation to materialize.

Another method, only recently having commercial success in France is the direct method of root inoculation. Commonly, bits or slices of truffle are mixed with the earth in proximity to the root systems of young oaks. (At one time, bits of truffle mycelia were sold in Paris and used in this way, resulting in wildly disparate tales of success and failure.)

The most recent and experimental approach is to grow the truffle fungus in the laboratory. The vegetative parts are



Dr. Jim Trappe searches for truffles with a fork inherited from his predecessor, renowned truffle expert, Dr. Helen Gilkey.

mixed with the soil of potted greenhouse-grown trees so that a root-truffle association will develop. The inoculated trees are later transplanted into orchards and an annual harvest of truffles can be expected for many years. The French National Institute for Agronomic Research now claims to have produced truffles three-and-one-half years after transplanting young trees with truffle fungi well-established on their root systems.

Even with new ways to grow this desirable fungus being developed, we wonder if a California truffle industry will get into the ground soon. Will little varmints of the forest devour the crops if it does? Will we ever lunch on rice made almost invisible by slices of fresh *Tuber gibbosum* sprinkled with Parmesan cheese? Will we follow it with roast pheasant covered with California-grown *Tuber melanosporum*? Will we then have a salad of sliced mushroom and *Tuber californicum* dressed with a savory sauce? Will we conclude with a cheese and truffle *fonduta*? Will we survive it all if we do?

William Breen has successfully adapted So. California mushrooms to a wide variety of culinary delights and would like to eventually change his current occupation as a men's sports shirt designer to that of a specialty chef.

The Natural History Museum's botanical collections contain some novel specimens that could have appeared over the years in Ripley's "Believe It or Not." Between 1912 and 1928, odd pieces of bark, wood "flowers" or even a yucca stalk shaped like a wriggling snake were some of the found objects contributed by their discoverers in the interests of natural history.

After more than fifty years of methodical, scientific collecting initiated by the permanent gift of the entire herbarium of the Southern California Academy of Sciences—which consisted of around 9,000 items—the Museum's present holdings are approximately 250,000 specimens of flowering plants, ferns, mosses and fungi. (When other herbaria need one of our herbarium sheets or packets for study, they refer to the Natural History Museum of Los Angeles County herbarium as LAM—the acronym assigned by the International Association of Plant Taxonomy.)

Most first-time visitors to a herbarium who may expect living plants—envisioning the entire third floor Botany Section as one huge greenhouse—are undoubtedly somewhat disappointed on finding instead rows of tall, drab green metal cabinets containing narrow shelves which support folders and envelopes of *dried* plants. Pressed flowering plants and ferns are glued to large sheets of stiff white paper (hence the term "herbarium sheet"), while mosses, lichens and fungi are simply placed in folded packets, all 250,000 of them, and all without the bother of watering and weeding! Furthermore, because of field activities by the curators and specimen exchange with other institutions, LAM is growing by almost 2,500 plants a year. (To facilitate better environmental control and to install space-saving cabinets on rails, the Botany Section with its offices, laboratories and expanding LAM is moving to a new location on the third floor—formerly Entomology and Photography—in the near future.)

Herbaria are used primarily for academic and scientific purposes. Each specimen in the collection carries data on labels useful to specialists in morphological, taxonomical or chemical ways. This information includes the plant's ecology, its geographical location, its collector and the date collected and, of course, its taxonomic name.

Ideally, a specimen representative of each of hundreds of thousands of plant species in the world would be nice to have for even general identification work. This is a goal that is seemingly being achieved by world-wide cooperation of many herbaria, with LAM's contribution from the floras of California and the Southwest, Mexico and the tropical Pacific basin and

surrounding areas stemming from the curators' expertise.

All this collecting and subsequent identification began with the hiring of a botanical curator by Museum Director F. S. Daggett in 1928. Perhaps the task to curate "a small and largely unorganized herbarium" proved to be too much, since the botanist Daggett employed labored only three weeks. However, the botanist had brought an assistant with him from the defunct California Botanic Gardens who stayed for a full year. This rapid rate of turnover was immediately halted by the next curator, B. C. Templeton, who remained for over forty years. Since 1928, eleven botanists have served as curators.

Presently, there are four County- or Foundation-salaried curators in the Botany Section of the Natural History Museum. These curators have geographic

ON THE LAM

by David Minor

as well as plant group specialties which affect their choices for field work and research. Dr. Don R. Reynolds works with fungi which occur on leaves in the American and Asian tropics. Dr. Christopher Davidson does general field work in Costa Rica and Bolivia. Dr. Sterling Keeley travels the American tropics to collect and study *vernonias*—members of the aster family—and Robert Gustafson makes the Hawaiian Islands his general collecting location.

Research Associates actively complement the curatorial work. Dr. William Emboden specializes in economic botany—especially drug plants. Dr. Fritz Zeylemaker works with cacti, and Dr. Jo-Min Yen concentrates on Southeast Asian parasitic fungi. Kenneth Curry car-

ries out research using both the light and the electron microscopes on a fungus that lives on the sap from tree bark wounds. Mushrooms of the Los Angeles basin are Florence Nishida's main interest.

Although casual Museum visitors will never see the LAM (except perhaps during open house for Alliance members), they will have increasing opportunities to see the LAM interpreted for them through both temporary and permanent exhibits. The space for a permanent botanical exhibit hall has recently been made available on the Museum's second floor (in the hall last used for Northwest Coast Indian artifacts) and will eventually displace the present display of plant models situated near the Museum director's office. Plans germinated over fifteen years ago will be refined and carried out for the next exhibits. Opening in November, 1979, with a temporary show entitled "Hawaii's Unique and Vanishing Flora," the hall will later be given over to a permanent display concerning the botany of the Los Angeles basin.

A factor in deciding the direction the theme of the display is to take was spurred by a survey taken by botany volunteers bringing to light over sixty botanical gardens and nature centers in greater Los Angeles. These numerous *living* resources and the Museum's LAM will be tied together conceptually in the planned exhibit with a focus on the positive role of fire in maintaining the ecological balance of nature.

As the history of the Botany Section passes the half-century mark, it can be recorded that more field work will be done, most often supported by grants and other private sources, in areas of the world where new species are yet to be discovered and where botanical frontiers are rapidly disappearing. LAM will greatly increase in size, temporary exhibits will come and go, and special esoteric research will ever be the life-work of botanists in the museum field.

Perhaps those oddities of shape and substance that initiated the Museum's botanical collections will someday go on display in a rarified atmosphere of nostalgia and curiosity. But the realities of the botanical research done behind the scenes will be the real backbone of the Museum's botanical history and reputation.

David Minor has contributed to botany activities including the publication, "Botanical Resources of Southern California," as well as having participated in several field trips to Hawaii. His work may currently be seen in the "Hawaii's Unique and Vanishing Flora" exhibit. He is involved in the planning of the permanent botany gallery.



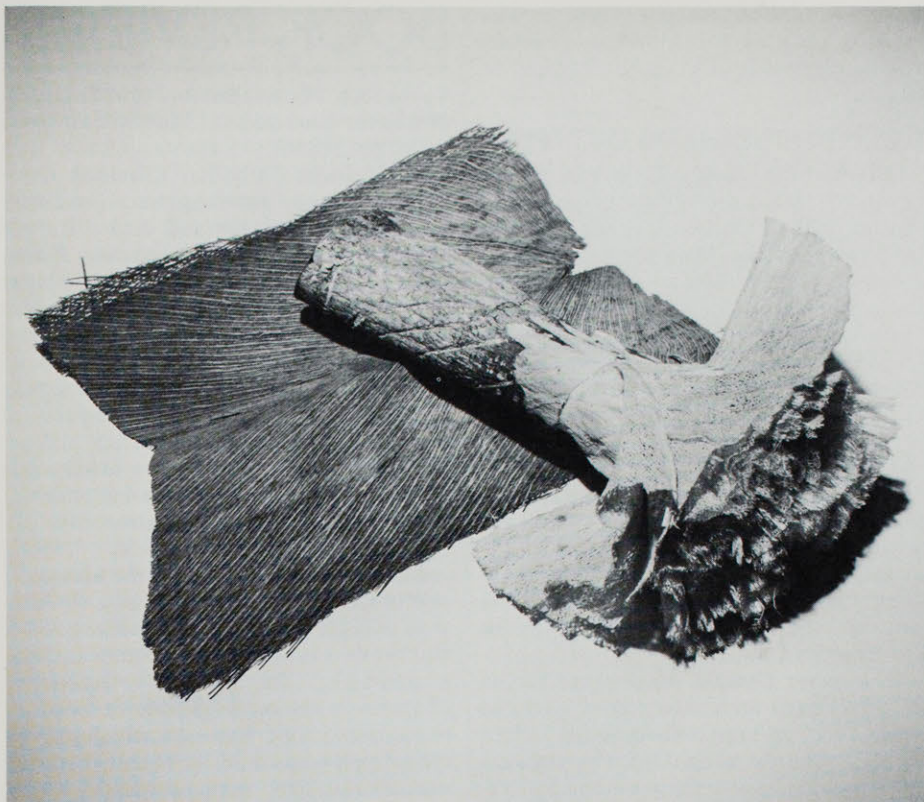
The LAM—Botany Volunteer John Flake confers with artist Francis Runyan between rows of herbarium cases instead of the lush green growing plants usually expected by a visitor to the botany laboratories.

8897- Herre Lichen Herbarium
PLANTS OF THE HAWAIIAN ISLANDS
 From the Herbarium of A. R. H. LAMBERTON
Gannaria lurida (Mont.) Nyls
 N. Maui-Puu Kuku Trail
 N. side Honokawai Gulch
 3000 - 5788 ft
 Coll. A. R. H. Lambertson Det. *antkerre*
 No. 1581 Date June 9, 1953

Dried plant material is kept in particular order in the herbarium along with important specimen information such as the place found, the collector (coll.) and the collector's number, the date collected, the scientific name of the plant, the person who determined the name (Det.), and the herbarium (LAM) number. The packet is from the well known A. W. Herre Lichen Collection.



George P. Rulesch of Los Angeles donated this yucca stalk in the form of a snake on 4 November 1913. This is believed to be the Museum's first botanical acquisition.



Two pieces of bark have rather mysterious histories. The "lace bark" (R) is from Jamaica via Mr. and Mrs. Barclay Chadwick. Someone had rolled up the piece of *Lagetta linteorine* bark like a cigar and then proceeded to make the end look as though it had exploded, en-

hancing the lacey appearance of the plant material. It was donated in 1931 by the owners of the Chadwick Hotel in Los Angeles. All that is on the label for the other specimen (L) is the name "skeleton" and it is probably from a palm.



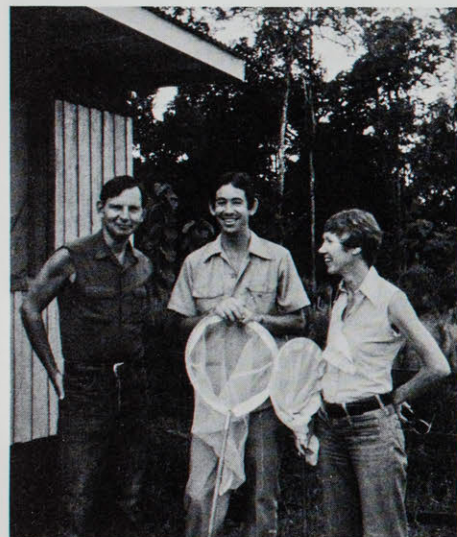
This is a typical dried herbarium specimen as it appears in the collection.



Mr. and Mrs. Howard Duncanson of Hollywood found this "wood tulip" in South America and gave it to the Museum's herbarium in August, 1927. The "sting of an insect" formed the "blossom" according to the Duncansons, but Curator Robert Gustafson claims that mistletoe causes such formations when the plant attaches itself to branches.

(Continued from page 2) herbarium specimens. The plants will provide important new information about this poorly-known area for a forthcoming flora of Costa Rica. In addition, Davidson collected a number of wood samples for studies of wood anatomy and the causes for the formation of buttresses in tropical trees.

Dr. Bezy's research was more limited in scope, but no less physically demanding: an investigation into the nature and origin of all-female (parthenogenetic) populations of the yellow-spotted night lizard, *Lepidophyma flavimaculatum*. In three weeks of sweaty, back-breaking work tearing apart rotten logs and searching through tree buttresses, Bezy and his crew (with the aid of local bounty hunters, at \$11.71 per lizard!) were able to secure more than forty live specimens for transportation back to Los Angeles. There, preparations of chromosomes and tissues will possibly shed light on the transition from unisexual to bisexual populations of this enigmatic species.



Team Leader Julian P. Donahue (left) with two of the 11 team participants, Dr. Christopher Hair and Nadine Moore, R.N., outside their jungle laboratory in Costa Rica.

ANNUAL NATIVE AMERICAN SHOW

The Ethnic Arts Shop annual Native American Show, a four-day festival of art, culture, and dance, will take place Thursday, December 6, through Sunday, December 9. Activities will include book-signings, lectures, films, and performances by two dance groups. The Inter-Tribal Dancers will perform traditional American Indian dances, while Esplendor Azteca will perform Pre-Hispanic dances of Mexico. Eight craftspeople will demonstrate their skills, one of whom, a Navajo weaver, will be coming all the way from Keams Canyon, Arizona. An expanded selection of fine Native American crafts will be for sale, including pottery, kachinas, basketry, old and new Navajo

weavings, and Alaskan sculpture. The evening opening for Alliance members will be Wednesday, December 5, from 7 to 10 p.m.

AUDUBON LITHOGRAPHS ON DISPLAY

Fifteen John James Audubon plates from the 1860 chromolithographic 2nd edition of the Double Elephant folio are on display in the Museum's 2nd Floor Changing Gallery. The great 19th century artist painted the known species of North American birds, and was one of the first artists to show birds in their native habitats. The plates are all from the Museum's own collection.

VISITOR FROM OUTER SPACE

The Natural History Museum's Mineralogy-Geology Section has acquired a meteorite of major local importance. The meteorite, found in Little Rock, California, a town near Palmdale, is only the second one found anywhere in Los Angeles County.

Discoverer Donald Reed came across the blackened forty-two-pound mass in April, 1979, on land owned by his father. He immediately recognized it as unusual and suspected it of being a meteorite. Taking a chip off of one corner he found the interior to be rock-like in appearance.

Mr. Reed sent the chip to Dr. Roy Clark, a meteorite expert at the Smithsonian. Dr. Clark, confirming that the rock is a meteorite, classified it as a bronzite chondrite, type H6, more popularly known as a stony meteorite. Meteorites of this kind consist chiefly of small spherical bodies (chondrules) made up of the minerals olivine and pyroxene together with grains of nickel-iron.

The meteorite was later examined by another expert, Dr. John Wasson of UCLA. He noted the black fusion crust of the meteorite to be remarkably fresh (that is, free of extensive weathering and oxidation). This, he stated, indicates that the fall occurred fairly recently perhaps within the last ten years, and certainly no longer than a hundred years ago.

The only other meteorite found in Los Angeles County was discovered in 1948 at Neenach. It is also a stony meteorite, and was found as several fragments totaling about fifty pounds. A major portion remains intact in the UCLA collection, while many small pieces have been sent around the world for scientific study.

The Little Rock meteorite will remain essentially intact and will be prominently exhibited in the Museum where the people of Los Angeles County can view their strange visitor from outer space.

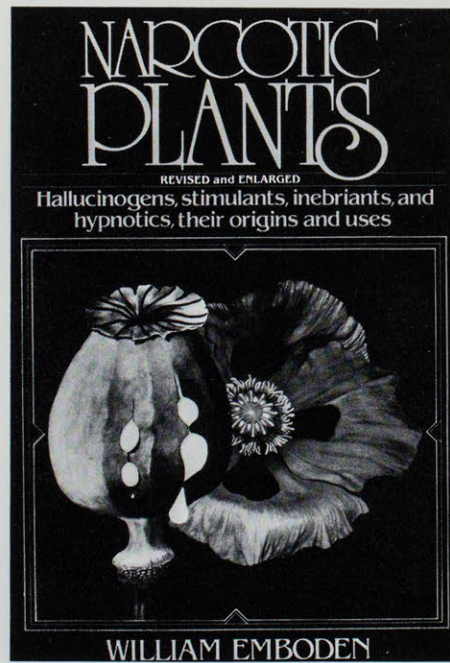
BOOK REVIEWS

Narcotic Plants, Revised and Enlarged. William Emboden., Macmillan xvii +206 pp. \$15.95.

Dr. William Emboden, Research Associate in Botany and frequent contributor to *TERRA*, has revised and enlarged his hugely successful *Narcotic Plants* which first appeared in 1972. Because of the many advances made in recent years in the fields of ethnobotany and ethnopharmacology of narcotic plants, he saw fit to expand and bring his first text up to date. Many intriguing aspects of botany, anthropology, chemistry and archaeology are woven into a fascinating narrative of how drug use has encompassed almost every civilization, both ancient and modern.

Dr. Emboden's account of the historical use of these plants, as well as a description of their botany and chemistry, make this work a must for the layman and scientist alike. The profusely illustrated chapters in the book include detailed information about hallucinogens, stimulants, hypnotics, inebriants and the enigmatic narcotic, tobacco. Appendices provide botanical, geographical and chemical information, as well as common or regional names and uses of the plants.

Robert J. Gustafson



Reef Fishes of the Sea of Cortez. The Rocky Shore Fishes of the Gulf of California. Donald A. Thompson, Lloyd T. Findley, and Alex N. Kerstitch. John Wiley and Sons, xvii +302 pp. \$34.50.

The collaboration of an ecologist, a taxonomist, and an artist-photographer with years of experience in the Gulf of California has resulted in an excellent

book on the reef fishes of this area. As stated by the authors, the treatment of the species is patterned after *The Fishes of the Bahamas* 1968 and the Gulf fauna is very similar in species composition to that of the Bahamas. For the first time we have a book to identify many of the common, visible reef fishes with excellent illustrations, many in color. Very small species and those that are only transient on the reef are covered in the text. English and Spanish common names are given, but unfortunately, scientific names are not yet available for some species.

The book starts with a good discussion of the reef habitat in The Gulf of California, and a description of the physical characteristics and how they affect the distribution of fishes. The authors characterize three fish communities representing the lower, middle, and upper Gulf of California, and document the predominantly tropical nature of the fish faunas. A short section on anatomy of fishes is good and provides (in addition to standard information) a clear illustration of vomerine and palatine teeth and a definition of gill raker rudiments, often a source of confusion to novices and seldom adequately explained.

Most of the book is comprised of species accounts followed by a discussion of non-resident reef fishes and a checklist of the reef fishes of the Gulf of California. The accounts are accurate and present much distributional, illustrative, and natural history information for the first time. Some of the distributional records should have been noted in the checklist, such as the apparently first eastern Pacific record (visual) for *Acanthurus achilles*. The grouping by taxonomic groups of the color and some black and white illustrations will greatly facilitate their use in identification. A few species (i.e., *Eupomacentrus rectifraenum*, *Holacanthus passer*, *Paranthias colonus*) are represented by both a color photograph and a color illustration as well as a black and white illustration. It would be nice to reduce this duplication in future editions, if other colorful species were available for substitution such as *Chaetodon falcifer*, and *Echidna zebra*. One typical reef form in the Cape Region, *Kuhlia taeniura* is not illustrated.

The book ends with a comprehensive bibliography to taxonomic and ecological work on Gulf Fishes. One hopes it will lead others to pursue the gaps in our knowledge pointed out in this book, and to produce an equally detailed work on the "non-reef fishes" as well. Certainly this merging of scientific disciplines has produced a book with a broader scientific, as well as popular, coverage of a regional fish fauna than many of its contemporaries.

Camm C. Swift

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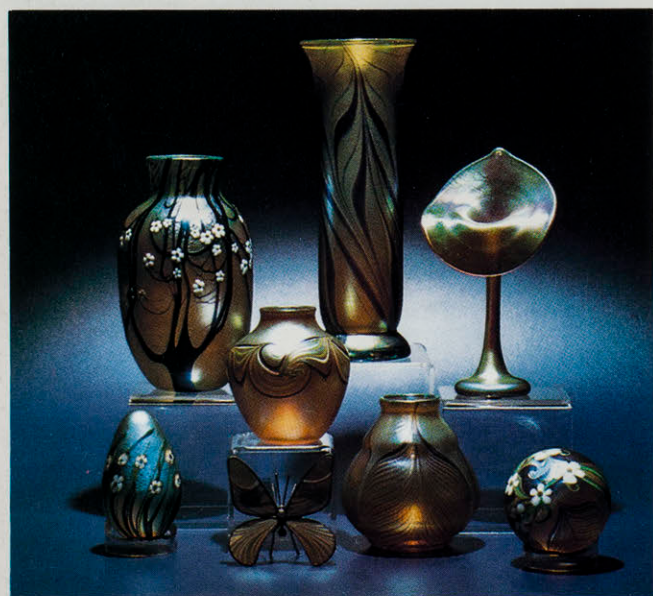
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